

Remarks

The Office Action dated 3 July 2002 has been received and reviewed. Claims 64 and 94 have been amended, and claims 66 and 96 have been cancelled. The pending claims are claims 64-65 and 67-95. Reconsideration and withdrawal of the rejections are respectfully requested.

Claim Amendment

Claim 64 has been amended to substantially include all of the elements of dependent claim 66.

Claim 94 has been amended to substantially include all of the elements of dependent claim 96.

No new matter was added.

The 35 U.S.C. § 102(e) Rejection

The Examiner rejected claims 64-65, 67-70, 72-75, 77-81, 83-86, 88-91, and 93 under 35 U.S.C. § 102(e) as being anticipated by Shiramizu (U.S. Patent No. 6,116,254).

Applicants traverse this rejection and submit that claims 64-65, 67-70, 72-75, 77-81, 83-86, 88-91, and 93 are not anticipated by Shiramizu for at least the following reasons. For a claim to be anticipated under 35 U.S.C. § 102(e), each and every element of the claim must be found in a single prior art reference. *See* M.P.E.P. § 2131.

Claims 64-65 and 67

Claims 64-65 and 67 are not anticipated by Shiramizu because such reference does not teach each and every element of claims 64-65 and 67. For example, claim 64, as amended, recites that the etching composition is in a range of about 1:1:25 (mineral acid:peroxide:deionized water) to about 1:1:10 (mineral acid:peroxide:deionized water). In contrast to claim 64, Shiramizu teaches a cleaning solution that includes a ratio of 1:1:6; therefore, Shiramizu does not teach each and every element of claim 64.

Claims 65 and 67, which depend from claim 64, are not anticipated by Shiramizu for the same reasons as presented above for claim 64. In addition, claims 65 and 67 each recite additional elements that further support patentability when combined with claim 64.

For at least the above reasons, Applicants submit that claims 64-65 and 67 are not anticipated by Shiramizu. Reconsideration and withdrawal of this rejection are, therefore, respectfully requested.

Claims 68-70, 72-75, 77-81, 83-86, 88-91, and 93

Claims 68-70, 72-75, 77-81, 83-86, 88-91, and 93 are not anticipated by Shiramizu because such reference does not teach each and every element of claims 68-70, 72-75, 77-81, 83-86, 88-91, and 93. For example, each of independent claims 68, 73, 77, 79, 84, and 89 recite that the claimed etching compositions include a specified etch rate. Claims 68 and 84 recite that the etching composition has an etch rate greater than about 1000 Å/minute for cobalt. Claims 73 and 79 recite that the etching composition has an etch rate of about 50 Å/minute to about 250 Å/minute for metal nitride. Claims 77 and 89 recite that the etching composition has an etch rate of about 50 Å/minute to about 250 Å/minute for metal nitride and an etch rate greater than about 1000 Å/minute for cobalt.

In contrast to independent claims 68, 73, 77, 79, 84, and 89, Shiramizu does not teach any etch rates for its disclosed cleaning solution. The Examiner, however, alleges that the cleaning solution taught by Shiramizu would inherently have a metal nitride etch rate of about 50 Å/minute to 250 Å/minute and a cobalt etch rate greater than about 1000 Å/minute because it is made from essentially the same concentration of each chemical as that of the claimed invention. Applicants traverse this allegation.

To establish inherency, the extrinsic evidence must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill. *In re Robertson*, 49 U.S.P.Q.2d 1949, 1950-51 (Fed. Cir. 1999); *see also Crown Operations Int'l Ltd. v. Solutia Inc.*, 62 U.S.P.Q.2d 1917 (Fed. Cir. 2002). Inherency, however, may not be established by probabilities or possibilities. The

mere fact that a certain thing may result from a given set of circumstances is not sufficient. *Id.* In *Crown Operations*, the Federal Circuit refused to adopt the approach suggested by plaintiffs that "if a prior art reference disclosed the same structure as claimed by a patent, the resulting property . . . should be assumed." See *Crown Operations Int'l Ltd. v. Solutia Inc.*, 62 U.S.P.Q.2d at 1922.

In this case, Applicants submit that the etch rates claimed by the present invention are not necessarily present in the teachings of Shiramizu for at least the following reasons. First, as stated above in *Crown Operations*, just because Shiramizu may disclose a cleaning solution having a similar structure as the etching composition claimed in the present invention does not necessarily imply that the cleaning solution of Shiramizu etches either metal nitride or cobalt at the claimed etch rates. As stated above, Shiramizu is silent regarding etch rates or etch rates for metal nitride and cobalt. Further, Shiramizu teaches cleaning methods and cleaning systems for cleaning a semiconductor substrate, not etching compositions for etching metal nitride and/or cobalt as claimed by the present invention.

Further, one skilled in the art would not recognize such etch rates in Shiramizu. As stated above, Shiramizu is silent regarding etch rates or etch rates of metal nitride and cobalt. Further, Shiramizu teaches cleaning methods and systems. Specifically, the section of Shiramizu pointed to by the Examiner teaches a cleaning process for removing metallic contaminants on the surface of a semiconductor substrate. See Shiramizu, column 1, lines 26-28. The term "metallic" is defined as "pertaining to metals in their uncombined forms." Grant et al., *Chemical Dictionary*, 5th ed., pg. 364 (1987) (attached herewith as Appendix A). In other words, Shiramizu teaches a cleaning process for removing only metals in their uncombined form, which would not include removing metal nitrides. Therefore, one skilled in the art would not recognize that the cleaning solution allegedly taught by Shiramizu would etch metal nitrides at the rates claimed by the present invention. In addition, one skilled in the art would not necessarily recognize that the cleaning solution taught by Shiramizu would also inherently be able to etch metal nitrides and/or cobalt at the etch rates claimed because cleaning solutions and etching solutions perform different functions.

For at least the above reasons, Applicants submit that the claimed etch rates are not necessarily present in Shiramizu, and one skilled in the art would not recognize that the cleaning solutions taught by Shiramizu could also etch metal nitride and/or cobalt at the etch rates suggested by the Examiner; therefore, the claimed etch rates are not inherently taught by Shiramizu. Because Shiramizu does not teach each and every element of independent claims 68, 73, 77, 79, 84, and 89, such claims are not anticipated by Shiramizu.

In regard to dependent claims 69-70, 72, 74-75, 78, 80-81, 83, 85-86, 88, 90-91, and 93, which depend from one of independent claims 68, 73, 77, 79, 84, and 89, such claims are not anticipated by Shiramizu for the same reasons as presented above for independent claims 68, 73, 77, 79, 84, and 89. In addition, claims 69-70, 72, 74-75, 78, 80-81, 83, 85-86, 88, 90-91, and 93 each recite additional elements that further support patentability when combined with independent claims 68, 73, 77, 79, 84, and 89.

For at least the above reasons, Applicants submit that claims 68-70, 72-75, 77-81, 83-86, 88-91, and 93 are not anticipated by Shiramizu. Reconsideration and withdrawal of this rejection are, therefore, respectfully requested.

The 35 U.S.C. § 103(a) Rejection of claims 66, 71, 76, 82, 87, and 92-96

The Examiner rejected claims 66, 71, 76, 82, 87, and 92-96 under 35 U.S.C. § 103(a) as being unpatentable over Shiramizu as applied to claims 64, 68, 73, 81, 86, and 91 above.

Applicants traverse this rejection and submit that claims 66, 71, 76, 82, 87, and 92-96 are not *prima facie* obvious for at least the following reasons. To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art references must teach or suggest all the claim limitations. See M.P.E.P. § 2143.

Claims 66 and 94-95

With regard to original claim 66, which has been incorporated into claim 64, original claim 66 is not *prima facie* obvious in view of Shiramizu because there is no motivation or suggestion given to modify the disclosed cleaning solution such that it includes a range of about 1:1:25 to about 1:1:10 as recited in amended claim 64. As stated above, Shiramizu teaches a cleaning solution, not an etching solution. One skilled in the art would not be motivated to modify the cleaning solution of Shiramizu to etch metal nitrides and/or cobalt as is provided by the present invention.

With regard to claims 94-95, such claims are not *prima facie* obvious for the same reasons as presented above for claim 66.

For at least the above reasons, Applicants submit that claims 66 and 94-95 are not *prima facie* obvious in view of Shiramizu. Reconsideration and withdrawal of this rejection are, therefore, respectfully requested.

Claims 71, 76, 82, 87, and 92-93

Claims 71, 76, 82, 87, and 92-93 are not *prima facie* obvious because Shiramizu does not teach or suggest all of the elements of such claims. For example, by reason of their respective dependencies, claims 71, 76, 82, 87, and 92-93 each recite etch rates for metal nitride and/or cobalt. For example, claims 71 and 87 recite that the claimed etching composition has an etch rate greater than about 1000 Å/minute for cobalt. Claims 76 and 82 each include the element that the etching composition has an etch rate of about 50 Å/minute to about 250 Å/minute for metal nitride. Further, claims 92-93 recite that the etching composition has an etch rate of about 50 Å/minute to about 250 Å/minute for metal nitride and an etch rate greater than about 1000 Å/minute for cobalt. As stated above, Shiramizu is silent regarding etch rates or etch rates for etching metal nitride and/or cobalt. Therefore, Shiramizu does not teach all of the elements of claims 71, 76, 82, 87, and 92-93.

Further, as described above, one skilled in the art would not be motivated to modify the cleaning solution taught by Shiramizu such that it etched metal nitride and/or cobalt at the recited etch rates.

For at least the above reasons, Applicants submit that claims 71, 76, 82, 87, and 92-93 are not *prima facie* obvious in view of Shiramizu. Reconsideration and withdrawal of this rejection are, therefore, respectfully requested.

The 35 U.S.C. § 103(a) rejection of claims 64-96

The Examiner rejected claims 64-96 under 35 U.S.C. § 103(a) as being unpatentable over Nakano et al. (U.S. Patent No. 6,110,839) in view of Shiramizu (U.S. Patent 6,116,254). Applicants traverse this allegation.

Applicants submit that claims 64-96 are not *prima facie* obvious because the cited references do not teach or suggest all of the elements of claims 64-96. As stated above, Applicants submit that Shiramizu does not teach all of the elements of claims 64-96. For example, Shiramizu does not teach an etching composition that includes a ratio in a range of about 1:1:25 to about 1:1:10 (e.g., claim 64). Further, Shiramizu does not teach etch rates for etching cobalt (e.g., claim 68), etching metal nitrides (e.g., 73), or etching both cobalt and metal nitride (e.g., claim 77).

The addition of Nakano et al. does nothing to address this deficiency already present in Shiramizu. For example, Nakano et al. teaches a method of purifying an alkaline solution and using the purified solution to etch semiconductor wafers. Nakano et al. does not teach an etching solution that includes a mineral acid, a peroxide, and deionized water. Instead, the portion of Nakano et al. relied upon by the Examiner teaches a cleaning solution of hydrochloric acid, hydrogen peroxide, and water. One skilled in the art would not be motivated to modify the cleaning solution of Nakano et al. to produce the etching composition recited in the pending claims because cleaning solutions and etching compositions are used for completely different purposes.

Further, Nakano et al. does not teach etching compositions that include the claimed etch rates for metal nitride and/or cobalt. Instead, the cleaning solution of Nakano et al. relied upon by the Examiner is used to remove metallic impurities. *See, e.g.,* Nakano, column 1, lines 54-57. In other words, the cleaning solution in Nakano et al. does not inherently describe the claimed etch rates because Nakano et al. does not teach an etching solution for etching metal nitride and/or cobalt. Inherency may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient. *In re Robertson*, 49 U.S.P.Q.2d 1949, 1950-51 (Fed. Cir. 1999).

For at least the above reasons, Applicants submit that claims 64-96 are not *prima facie* obvious in view of the cited references. Reconsideration and withdrawal of this rejection are, therefore, respectfully requested.

Amendment and Response

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Serial No.: 09/560,268

Confirmation No.: 2517

Filed: 26 April 2000

For: COMPOSITION FOR SELECTIVELY ETCHING AGAINST COBALT SILICIDE (As Amended)

Summary

It is respectfully submitted that the pending claims are in condition for allowance and notification to that effect is respectfully requested. The Examiner is invited to contact Applicants' Representatives, at the below-listed telephone number, if it is believed that prosecution of this application may be assisted thereby.

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APPENDIX A - CLAIM AMENDMENTS
INCLUDING NOTATIONS TO INDICATE CHANGES MADE

Serial No.: 09/560,268

Docket No.: 150.00560102

Amendments to the following are indicated by underlining what has been added and bracketing what has been deleted.

In the Claims

For convenience, all pending claims are shown below.

64. **(Once Amended)** An etching composition, the composition comprising a mineral acid, a peroxide, and deionized water at a ratio in a range of about [1:1:35]1:1:25 (mineral acid:peroxide:deionized water) to about [1:1:5]1:1:10 (mineral acid:peroxide:deionized water).
65. The etching composition according to claim 64, wherein the mineral acid is HCl and the peroxide is hydrogen peroxide.
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67. The etching composition according to claim 64, wherein the mineral acid is selected from the group consisting of HCl, HNO₃, H₂SO₄, H₃PO₄, and HF.
68. An etching composition, the composition comprising a mineral acid, a peroxide, and deionized water at a ratio in a range of about 1:1:35 (mineral acid:peroxide:deionized water) to about 1:1:5 (mineral acid:peroxide:deionized water), wherein the composition has an etch rate greater than about 1000 Å/minute for cobalt.
69. The etching composition according to claim 68, wherein the mineral acid is HCl.
70. The etching composition according to claim 68, wherein the peroxide is hydrogen peroxide.

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71. The etching composition according to claim 68, wherein the ratio is in a range of about 1:1:25 (mineral acid:peroxide:deionized water) to about 1:1:10 (mineral acid:peroxide:deionized water).

72. The etching composition according to claim 68, wherein the composition has an etch rate of about 50 Å/minute to about 250 Å/minute for metal nitride.

73. An etching composition, the composition comprising a mineral acid, a peroxide, and deionized water at a ratio in a range of about 1:1:35 (mineral acid:peroxide:deionized water) to about 1:1:5 (mineral acid:peroxide:deionized water), wherein the composition has an etch rate of about 50 Å/minute to about 250 Å/minute for metal nitride.

74. The etching composition according to claim 73, wherein the mineral acid is HCl.

75. The etching composition according to claim 73, wherein the peroxide is hydrogen peroxide.

76. The etching composition according to claim 73, wherein the ratio is in a range of about 1:1:25 (mineral acid:peroxide:deionized water) to about 1:1:10 (mineral acid:peroxide:deionized water).

77. An etching composition, the composition comprising a mineral acid, a peroxide, and deionized water, wherein the composition has an etch rate of about 50 Å/minute to about 250 Å/minute for metal nitride and an etch rate greater than about 1000 Å/minute for cobalt.

78. The etching composition according to claim 77, wherein the mineral acid is HCl and the peroxide is hydrogen peroxide.

79. An etching composition, the composition comprising a mineral acid, a peroxide, and deionized water, wherein the composition has an etch rate of about 50 Å/minute to about 250 Å/minute for metal nitride.

80. The composition according to claim 79, wherein the mineral acid is HCl and the peroxide is hydrogen peroxide.

81. The etching composition according to claim 80, wherein the composition comprises a ratio in a range of about 1:1:35 (mineral acid:peroxide:deionized water) to about 1:1:5 (mineral acid:peroxide:deionized water).

82. The etching composition according to claim 81, wherein the composition comprises a ratio in a range of about 1:1:25 (mineral acid:peroxide:deionized water) to about 1:1:10 (mineral acid:peroxide:deionized water).

83. The composition according to claim 79, wherein the mineral acid is selected from the group consisting of HCl, HNO₃, H₂SO₄, H₃PO₄, and HF.

84. An etching composition, the composition comprising a mineral acid, a peroxide, and deionized water, wherein the composition has an etch rate greater than about 1000 Å/minute for cobalt.

85. The composition according to claim 84, wherein the mineral acid is HCl and the peroxide is hydrogen peroxide.

86. The etching composition according to claim 85, wherein the composition comprises a ratio in a range of about 1:1:35 (mineral acid:peroxide:deionized water) to about 1:1:5 (mineral acid:peroxide:deionized water).

87. The etching composition according to claim 86, wherein the composition comprises a ratio in a range of about 1:1:25 (mineral acid:peroxide:deionized water) to about 1:1:10 (mineral acid:peroxide:deionized water).

88. The composition according to claim 84, wherein the mineral acid is selected from the group consisting of HCl, HNO₃, H₂SO₄, H₃PO₄, and HF.

89. An etching composition, the composition consisting essentially of a mineral acid, a peroxide, and deionized water, wherein the composition has an etch rate of about 50 Å/minute to about 250 Å/minute for metal nitride and an etch rate greater than about 1000 Å/minute for cobalt.

90. The composition according to claim 89, wherein the mineral acid is HCl and the peroxide is hydrogen peroxide.

91. The composition according to claim 90, wherein the composition comprises a ratio in a range of about 1:1:35 (mineral acid:peroxide:deionized water) to about 1:1:5 (mineral acid:peroxide:deionized water).

92. The composition according to claim 91, wherein the ratio is in a range of about 1:1:25 (mineral acid:peroxide:deionized water) to about 1:1:10 (mineral acid:peroxide:deionized water).

93. The composition according to claim 89, wherein the mineral acid is selected from the group consisting of HCl, HNO₃, H₂SO₄, H₃PO₄, and HF.

94. **(Once Amended)** An etching composition, the composition comprising a mineral acid, a peroxide, and deionized water at a ratio in a range of about [1:1:35]1:1:25 (mineral acid:peroxide:deionized water) to about [1:1:5]1:1:10 (mineral acid:peroxide:deionized water),

Applicant(s): Lee et al.

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wherein the mineral acid is selected from the group consisting of HCl diluted to 37% by weight in deionized water, HNO₃ diluted to 70% by weight in deionized water, H₂SO₄ diluted to 96% by weight in deionized water, H₃PO₄ diluted to 85% by weight in deionized water, and HF diluted to 49% by weight in deionized water, wherein the peroxide is selected from the group consisting of hydrogen peroxide diluted to 29% by weight in deionized water, and ozone.

95. The etching composition according to claim 94, wherein the mineral acid is HCl and the peroxide is hydrogen peroxide.

96. Cancel